Author designated	Nick Mardesich Jet Propulsion Laboratory Mail Stop 303-308 4800 Oak Grove drive Pasadena, California 91109-8099
Phone	(818) 354-9520
Fax	(818) 393-4272
e-mail	nick.mardesich@jpl,nasa.gov
category	4-C
presentation	oral

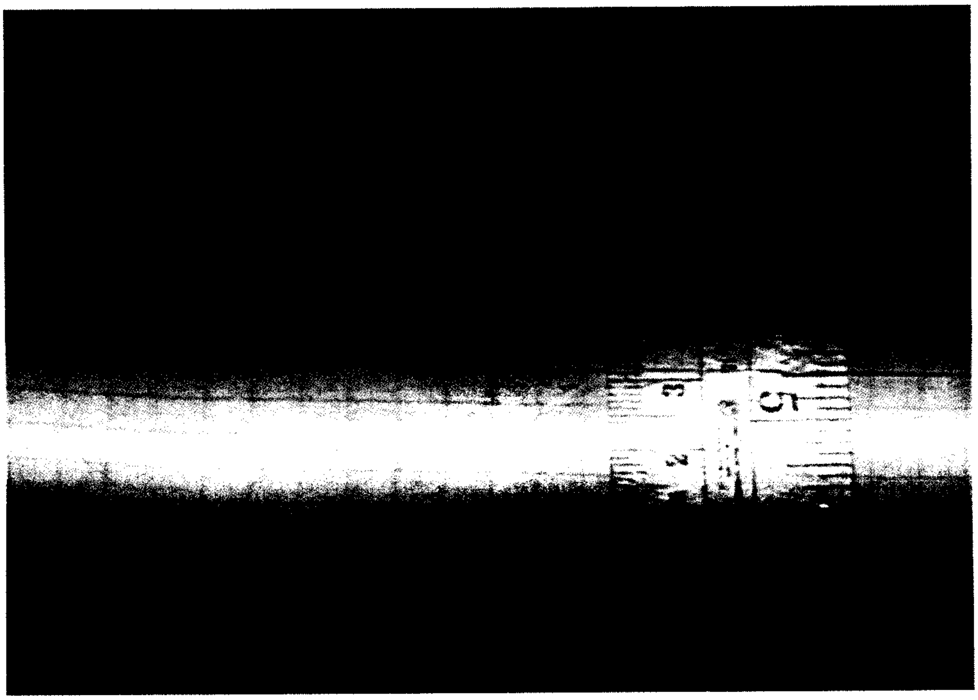
HIGH EFFICIENCY SPACE POWER CONVERSION SYSTEM

N. Mardesich and V. Shields
California Institute of Technology
Jet Propulsion Laboratory
Mail Stop 303-308
4800 Oak Grove drive
Pasadena, California 91109-8099

ABSTRACT

Power is an essential requirement for satellites in space but requires valuable real estate to absorb the solar energy. Increasing the efficiency of solar cells is the most desirable method to increase power to our modern satellites. State of the art solar cells are epitaxially stack structures with 3 or 4 junctions of different band gaps that utilize the desirable portions of the spectrum and convert them to electrical energy. These cells can produce efficiencies in the 30% range but are limited, since the top cells will absorb some energy needed for the bottom cells and the cells must be current matched. An alternative approach is to split the spectrum and expose adjacent cells of different band gaps with the spectrum where they are most efficient. This spectrum splitting concept was originally proposed in the 1950's with dichroic filters, but was unrealistic due to the limited selection of solar cells.

The current effort described in this paper is a modification of this original concept that takes advantage of the advanced solar cell technology and uses ten adjacent prisms as the spectrum splitting device (Figure1). Initial test results of 35% (Table 1) reported in this paper was conducted at JPL using 3 cells ($InGaP_2$/GaAs/InGaAs) at one sun. This initial data is consistent with Figure 2 and suggests that efficiencies in the range of 60% are possible with the spectrum splitting approach. Evaluations are continuing using solar concentrators capable of producing up to 15 sun concentration. The design of this system and the results of preliminary testing are presented.

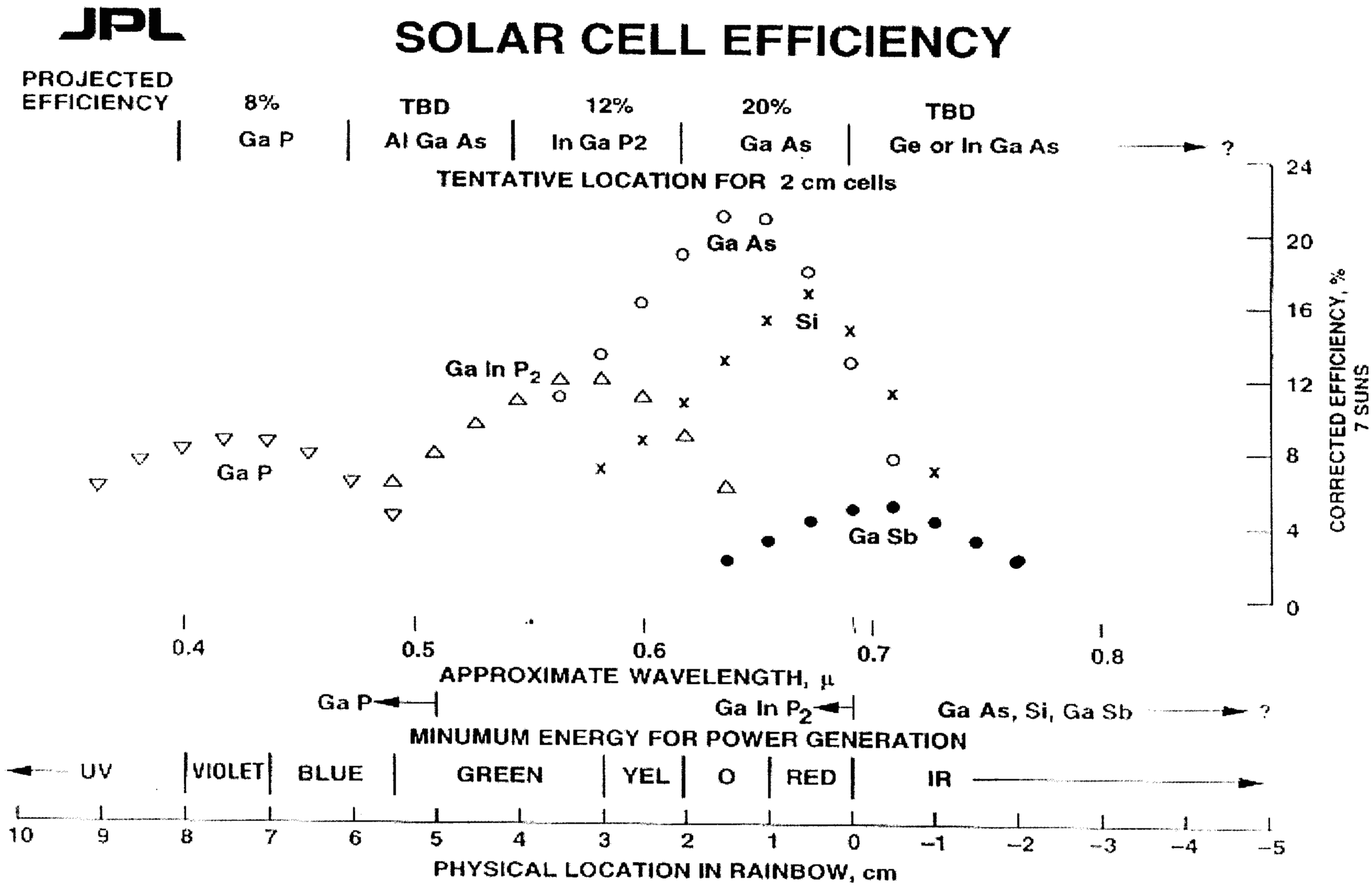


Rainbow image from ten adjacent prisms
Figure 1

Table 1

Rainbow Cell Test Results

Cell	Efficiency (AM0)
$InGaP_2$	12.15%
GaAs	19.13%
InGaAs (0.62eV)	3.71%
Total	35%



JPL
SOLAR CELL EFFICIENCY
PROJECTED EFFICIENCY
8%
Ga P
TBD
Al Ga As
12%
In Ga P2
20%
Ga As
TBD
Ge or In Ga As
?
TENTATIVE LOCATION FOR 2 cm cells
Ga As
Si
Ga In P2
Ga P
Ga Sb
24
20
16
12
8
4
0
CORRECTED EFFICIENCY, %
7 SUNS
0.4
0.5
0.6
0.7
0.8
APPROXIMATE WAVELENGTH, µ
Ga P
Ga In P2
Ga As, Si, Ga Sb
?
MINUMUM ENERGY FOR POWER GENERATION
UV
VIOLET
BLUE
GREEN
YEL
O
RED
IR
10
9
8
7
6
5
4
3
2
1
0
−1
−2
−3
−4
−5
PHYSICAL LOCATION IN RAINBOW, cm

Figure2